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Microcontroller Based Automated Water Level Sensing and Controlling

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ABSTRACT: The main objective of this project is water levelmonitoring and management within the context of electrical conductivity of the water. More specifically, we inquire the microcontroller based water level sensing and controlling in a wired and without wire (wireless) environment. Managementof Water Level approach would help in reducing the home power consumption and as well as water exceeding level of water (overflow). More additionally, it can indicates the amount(quantity) of water in the tank that can support all Water tapsby cellular data loggers, satellite data transmission systems for remote water monitoring system. Moreover, cellular mobile phones with comparative more computation power and higher quality Pictorial (graphical) user interface became being recently. From the costumersview it is required to reusage of such a valuable resource in anapplication of mobile. Finally, we designed a web and monitoring service protocol by cellular would determine and senses water level globally.

KEYWORDS: Conductivity, indicator, microchip, nozzle,and water level sensor.

I.INTRODUCTION

The water is a precious for human and living organism and now a day the water quality and wastage is a big issue. This is done by lower water treatment management and wastages of Water. It is commonly used for industry, agriculture and domestic consumption. Therefore, efficient use and water monitoring are potential binding for home and company water management system. Last few decades several monitoring system integrated with level of water detection have become agreed. Measuring water level is an essential task for government and residence perspective. In this way, it will be possible to follow the actual implementation of such initiatives with integration of various controlling activities. Therefore, controlling system of water implementation makes potential significance in home applications. The existing automated level detection method is described and that can be used to make a device on/off. Moreover, the common control of home appliance is simply to start the feed pump at a low level and allow it to run until a higher level of water is reached in the tank. This is not properly supported for adequate controlling system. Behind this, liquid level control systems are most widely used for monitoring of liquid levels, reservoirs, dams, and soils etc. as usually, this systems provides visual multi-level as well as continuous level indication. Audio alarms at desired levels and control of pumps are automated based on user's requirements can be included in this management system. When proper monitoring is needed to ensure water sustainability is actually being reached to sensing and automation. Such approach of programmatic details microcontroller based automated water level sensing and controlling.

II. BASIC CONCEPTS

The technique of water level monitoring and controlling system concentrated with some basic methods in our proposed method. Basic descriptions of some parts are described below.

A. Indication of water level

For water level indication unit we can use some LED light which will work for indication of water level. Through the different water levels through water level sensor, LED should be indicated as off/on (i.e. on: yes sensor senses water).

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B. Water Level Sensor

To make special water level sensor we would like to introduce some materials such as Iron rod, nozzles, resistance, rubber etc. A connecting rod made by iron,steel and it should be connected with ground and we need at least four nozzles which should be connected with power supply +5v via a resistance of 1kΩ. We need to joint them together and put a rubber at their joint point which will act as an insulator for nozzle. Whenever the sensor will touches the water, nozzles and connecting rod get electric connection using water conductivity [3].

C. Water Pump Controlling System

We can control the water pump by connecting it with an output pin of microcontroller through motor driver circuit. When microcontroller sends a positive signal (+5v) or a ground signal (0volt) to the motor driver circuit, the water pump become on or off respectively. We also would like to uses a manual switch for the motor driver circuit which is supposed to use for controlling it manually. It is a user friendly system.

D. Microcontroller

Microcontroller is a computer on a chip that is programmed to perform almost any control, monitoring, sequencing, and displays the function. Because of its relatively low cost, it becomes the natural choice of designer. Microcontroller is designed to be all of that in one. Its great advantage is no other external components are required for its application because all needed peripherals are already built into it. Thus, we can save the space,time, and cost which is required to generate a low cost devices [1].

E. Others

To control some high power devices such as lights,solenoids, heaters, and motor with a microcontroller we need interface devices between the high power devices of microcontroller pins. Mechanical relays are called as contactors are available to switch currents from mille ampere to thousands of amperes. In this system we should use a relay circuit with the water pump to adapt with higher voltage ac current. The output of relay circuit should be connected with motor's negative side of the cable. The (+) ve side of the cable shall be connected with 220v ac current. So, we can use electromagnetic relay as an electrical type amplifier.

III. PIC 16F84A MICROCONTROLLER

PIC is a family of RISC microcontrollers made by variable Microchip Technology is derived from the PIC1650 that is originally developed by General Instrument's Microelectronics Division. It is the integrated circuit which is usually developed to control peripheral devices and alleviating the load from the main Central Processing Unit. It is compared to a human being, the brain is the main CPU and the PIC is equivalent to the autonomic nervous system. If, we propose a lower cost of 8-bit PIC 16F84A microcontroller as a central controller of our system [1].

A. PIC 16F84A Block Description

The PIC 16F84A contain the mid-range family of the PICmicro® microcontroller devices. When the program memory contains 1K words, it is translates to 1024 instructions, since each 14-bit program memory word is same width of each device instruction. The data memory (RAM) contains 68 bytes [1]. Data EEPROM is 64 bytes. There are also contain the 13 I/O pins that are user-configured on a pin-to-pin basis. Some pins are multiplexed with other device functions.

B. Memory Organization

There are two memory blocks available in the PIC 16F84A which are program memory and data memory [14]. When the flash Memory is used to store the variable program. The size of program memory is 1024 locations with 14 bits width. It can be rewritten very large amount of times for updating purpose. Even if power is switched off the contents of flash memory will not be lost because of their contain the EEPROM. Data registers are generally used to keep numeric values such as floating-point values and integer. It can work as accumulator of the memory. Data memory has been partitioned into special purpose registers and general purpose registers which are used to store data address etc. and hold programs state respectively.

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IV. DESIGN AND IMPLEMENTATION

For this experiment design we have been using an 8 bit microcontroller, an inverter, a reserve tank (res. tank), water pump and watertank. Water pump has been used to control the water level sensor. Four homemade water level sensors are used to detect the water level. Inverted sensor data used to pass as the input of microcontroller [6]. We used the MPLAB programming software to write into PIC 16F84A memory [1].

A. System Architecture

At the first stage of water level sensor has been made for sensing the water level accurately. Microcontroller is used to control the overall systems are automatically reduces the design and control complexity. Microcontroller takes input from the sensor unit which senses the water level through inverter.

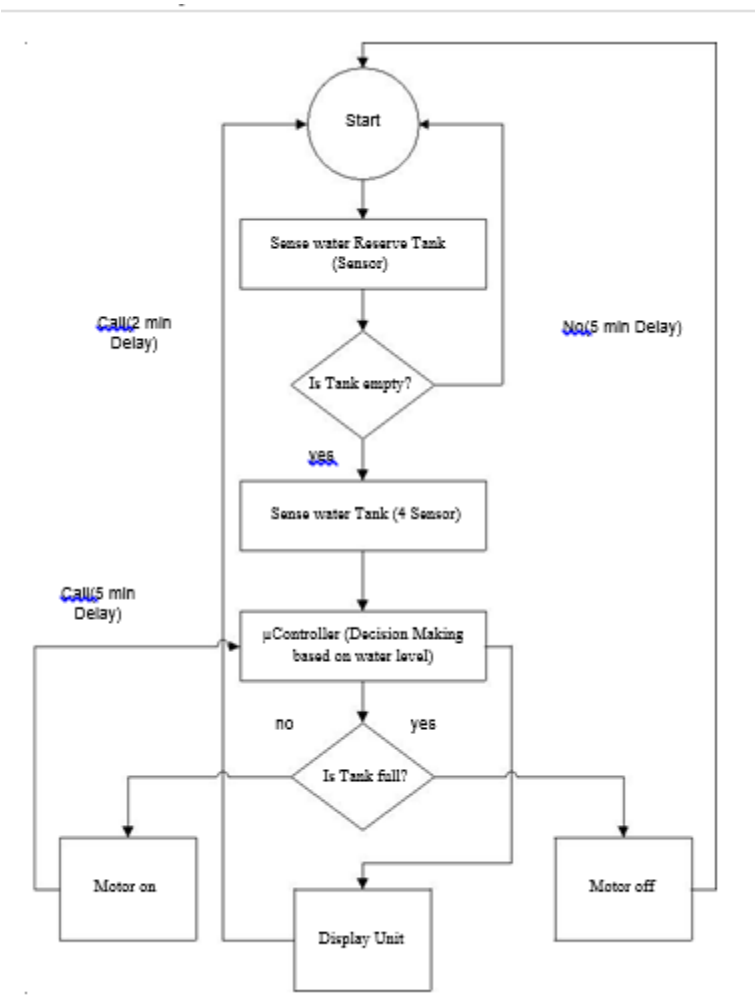

Figure 1: Flow chart of system design

B. Sensor Unit

Water level sensor unit consist two parts, one sensor is used in the reserve tank and other 4 sensors placed inside water tanks. Moreover, sensors are composed with inducting rubber rod, nozzles etc. Rod is made by iron and steel, that is connected with ground. Nozzles are connected with +5v. Nozzles and Iron rod are binding together via a rubber.

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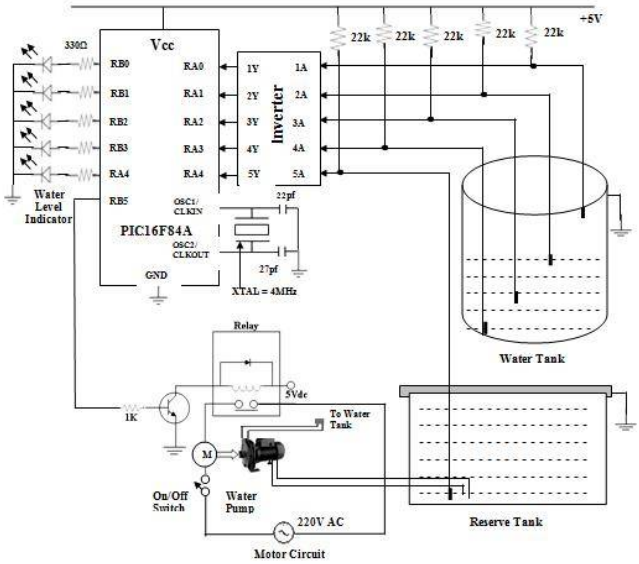

Figure 2: Complete circuit diagram

is used to make the electrical connection of nozzlesand iron rod separate. Due to water conductivity 22kΩ resistance has been used. The basic operation is, when one nozzle of sensor is drawn in water, nozzle, rod becomes connected due to water conductivity. Then nozzle gets ground signal (0v) which is connected with input of the inverter.

Control unit performs following actions:

1) ***Off operation:*** When the microcontroller sends 0 volt tothe base of the transistor then it becomes off and its emitter and collector becomes open. Then no ground signal (0v) is collected in the relay circuit. So, the negative side in the cable of motor pumps getting positive signal (+5volts). Therefore, the motor pump will be OFF because of getting positive signal (+5v) at one side and 220v ac at another end.

2) ***On operation:*** Transistor becomes on when themicrocontroller sends positive signal (+5v) and its emitter and the collector become shorter. Relay circuit and motor pump will get ground signal (0v) and for this reason the motor pump will be ON due to getting ground at negative side and 220v ac to the other side.

In addition, the current is changed up to positive signal (+5v) to ground or its reverse then the inductor can tolerate some resistance. For this reason we should use a diode. An on/off switch is used to control the motor driver circuit manually. Control unit's diagram shown in Fig. 2 with PIC16F84A microcontroller.

D. Operation Description and Complete Circuit Diagram

To implement the system we should use some necessary parts such as PIC 16F84A microcontroller, Crystal Oscillator, 2 capacitor having capacitance 22 pF and 27 pF, inverter, LED, water tank, water level sensor, water pump, transistor, inductor and some capacitor. The graphical Figure of the whole circuit diagram is shown in Fig. 2. RA4 pin of the microcontroller is used to detect the existence of water in the reserve tank. If no water available there, it sends a signal that controls the whole circuit and switch it OFF for a certain amount of time. And when the timer becomes on it senses the reserve tank again. RA0, RA1, RA2 and RA3 pins are used to get inverted output from the water source. Pin 15 and 16 of microcontroller are connected with a Crystal Oscillator. The other side of crystal oscillator is connected with the ground via two capacitors having 22 pF and 27 pF respectively which performs as an external clock generator to execute the instructions of the program.If four pins RA0, RA1, RA2 and RA3 gets ground signal (0v) that means there is no water in the water tank. So, all LEDs should be off. We can also set this issue more intelligent way, if pin RA3 senses ground signal then we can be sure that there is no water in the tank. And if we found pin no RA0 senses positive

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signal (+5v) then we can tell that water tank is full of water. So, when water tank is empty then water pump should become on and all LED light becomes off. If pin no RA3 gets positive signal (+5v) and other three gets ground signal (0v) that means water tank has 1/4th water. For this reason water pump remains on and the first LED should be on now; other three LEDs are still remaining off. If the four pins RA0, RA1, RA2 and RA3 get positive signal (+5v) that means water tank is now full of water. For this reason the water pump should be off now and all the LEDs should be on.

When the water is decreasing from the tank by home use, the display LED should start to become OFF one after another from the top to bottom. If all the LEDs becomes OFF that means the tank becomes empty again and the water pump should become automatically ON again exactly after the last LED becomes OFF. These operations should automatically perform as a cycle. The corresponding experimental result is presented here (see Table I).

E. Programming Description

The program we used to control the entire process is written in PIC16F84A microcontroller's assembly language. All the codes have been tested and simulated using MPLAB

TABLE I

EXPERIMENTAL RESULT OF WATER LEVEL SENSING UNIT, MOTOR AND VISIBLE LEVEL DESCRIPTION FOR USER BY LED LIGHT

Inverted Input From Water Sensor		Output						
Res. Tank	Water Tank	LED 1	LED 2	LED 3	LED 4	Motor	Tank	Reserve Tank
0	0000	OFF	OFF	OFF	OFF	OFF	Empty	Empty
1	0000	ON	OFF	OFF	OFF	ON	Empty	Water Exist
1	1000	ON	ON	OFF	OFF	NO OP.	1/4	Water Exist
1	1100	ON	ON	ON	OFF	NO OP.	2/4	Water Exist
1	1110	ON	ON	ON	ON	NO OP.	3/4	Water Exist
1	1111	ON	ON	ON	ON	ON	Full	Water Exist

software which is provided by MICROCHIP [1]. The external timer we have used in our system is a Crystal Oscillator (XTAL) 4MHZ. When the system powered up, microcontroller took the input from the water sensor through the inverter. Inverted inputs from RA0, RA1, RA2 and RA3 of microcontroller are loaded by register and its combination is being checked. The combination checking was done in the following way.

1) When microcontroller gets the first pin signal then it loads the signal to its register. After that it checks the next pin signal and then loads it to its register. Other pin signals operation also done respectively in the same way. Finally it loads all (four) required pin's signal to the register. By using these four signal combinations it decides an output

2) and sends that signal to the output pin.

3) The whole operation makes a cycle or repeats itself with respect to the input signals.

V.PROPOSED WATER LEVEL MONITORING NETWORK

Water, one of the great natural resources should be utilized in proper form. But a huge amount of water is being wasted during daily life due to lack of control. Our proposed system guarantees to accumulate a good amount of usable water every day. This monitoring and controlling system uses daily life device like laptop or mobile phone. Due to the fact of controlling remotely we introduced a useful wireless automated controlling system. This proposed web based monitoring and controlling network can work with the existing water controlling system successfully as

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described graphically in Fig. 3.We would like to partition this whole proposed wireless network in the following manner.

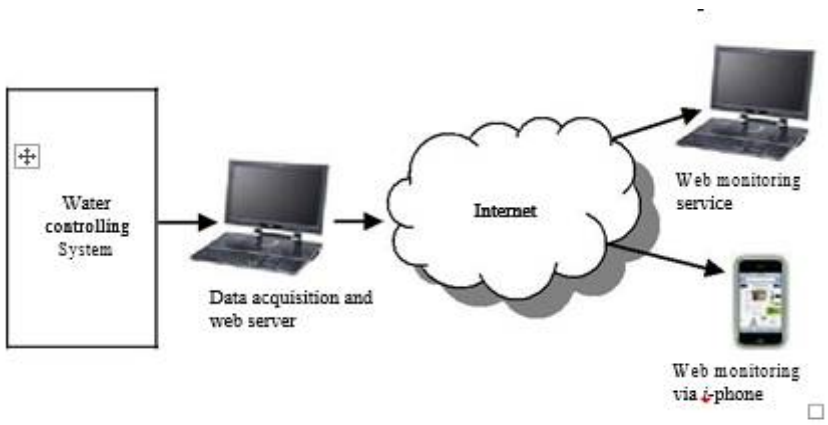

Figure 3: Water level monitoring network

A. Data communication

1) Step1: Data acquisition from water level sensors (WLSi) where i equal to 1……..3.4.5. And WLS could be connected to a computer via wireless or USB cable.

2) Step2: Data should be taken in fixed time duration. Controlling server should get serialized data via external port.

3) Step3: Each of these bits represents different sensors activities. Data should be sent in the bit order.

4) Step4: Microcontroller should deliver data in datagram packet or data communication could be UDP and TCP. In addition, data should be formed with a particular time's instance.

B. Data acquisition and representation

1) Step1: Data acquisition server should bind the specific port that is assigned from data communication protocol.

2) Step2: Received Data should store in buffer and process stored data to represent in web based application.

3) Step3: Data should be transformed into XML format. Data could be sending from server via SOAP data passing protocol.

4) Step4: Data representation should be in graphical user interface for users viewing and therefore they should have secured access to control microcontroller. In case of water level indication, notification message could be included in XML file.

5) Step5: Data sending method should maintain Interface serializability. Moreover, PC server should support multi-client and store acquired data in buffer that user can access database and control microcontroller. In addition, user authorization should be included in this section for security perspective.

C. Remote communication

1) Step1: Design interactive application software for remote PC or mobile should display data in table format or in the graphical interface for integration of the wireless water level monitoring.

2) Step2: Display the available local connections and the stored remote connections through the internet. Moreover, Display different data of wireless automated controlling system by different sort (sensors/actuators in one node, all

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devices in a room, all devices in an apartment/factory).

3) Step3: Display the whole network structure for the maintenance user.

VI. CONCLUSION

Water is one of the most important basic requirements for all living human beings and also for all living beings. But unfortunately a huge amount of water is being wasted by uncontrolled use of water. Some other water level monitoring system with automated is also offered so far but most of the method has some brief in practical. We were tried to overcome these problems and implemented an efficient automated water level monitoring and controlling system. Our intense of this research work was to establish a flexible, economical and easy configurable system which can solve our water waste problem. We have been used a low cost PIC 16F84A microcontroller in this system which is the key point to reduce cost.

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